Melting model of Hawaiian plume

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Eclogite component entrained in ascending plume is essentially important in producing flood basalts (e.g., Columbia River basalt, Takahashi et al., 1998 EPSL), alkalic OIBs (e.g., Kogiso et al.,2003), ferro-picrites (Tuff et al.,2005) and Hawaiian shield lavas (e.g., Hauri, 1996; Takahashi & Nakajima, 2002, Sobolev et al.,2005). Various melting models of Hawaiian plume have been proposed with entrained mafic components (e.g., Farnetani & Hofmann 2009; 2010). Size of the entrained eclogite, which controls the reaction rates with ambient peridotite, however, is very difficult to constrain using geophysical observation. Based on reconstruction of Koolau volcano by submarine study on Nuuanu landslide (AGU Monograph vol.128, 2002, Takahashi Garcia Lipman eds.), Takahashi & Nakajima (2002 ibid) concluded that the Makapuu stage lava in Koolau volcano was supplied from a single large eclogite block of the order of 1000km^3.

In order to study melting process in Hawaiian plume, high-pressure melting experiments were carried out under dry and hydrous conditions with layered eclogite/peridotite starting materials. Detail of our experiments will be given by Gao et al (04g: this conference). Combined previous field observation with new set of experiments, we propose that variation in SiO_2 among Hawaiian tholeiites represent varying degree of wall-rock interaction between eclogite and ambient peridotite. Makapuu stage lavas in Koolau volcano represents eclogite partial melts formed at ~3 GPa with various amount of xenocrystic olivines derived from Pacific plate. In other words, we propose that "primary magma" in the melting column of Hawaiian plume ranges from basaltic andesite to ferro-picrite depending on the lithology of the source. Solidus of peridotite lowers significantly due to FeO, TiO_2, K_2O from eclogites thus PMT of Hawaiian plume may be ~1450°C which is significantly lower than current estimates (e.g., Herzberg, 2006).

Aoki & Takahashi (2004 PEPI) studied density change in MORB eclogite with pressure and temperature (5-14GPa). We extended this study into the melting range of the Hawaiian plume (3-8GPa). Behavior of entrained eclogite block in Hawaiian plume will be discussed based on the new density model.